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(54) Buffer tube coupling coil and method of installing a fiber optic cable

Hüllrohrwindung zur Ankopplung eines faseroptischen Kabels und Methode zur Installation eines faseroptischen Kabels

Bobine de couplage d'un tube de protection et procédé d'installation d'un cable à fibres optiques

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- **PATENT ABSTRACTS OF JAPAN vol. 2003, no. 02, 5 February 2003 (2003-02-05) & JP 2002 311315 A (KYUSHU UCHIDA TANKO KK), 23 October 2002 (2002-10-23)**
- **HOGARI K ET AL: "OPTICAL FIBER CABLES FOR RESIDENTIAL AND BUSINESS PREMISES" JOURNAL OF LIGHTWAVE TECHNOLOGY, IEEE. NEW YORK, US, vol. 16, no. 2, February 1998 (1998-02), pages 207-213, XP000750659 ISSN: 0733-8724**

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to the termination of fiber optic cable by a buffer tube coupling coil to couple the fiber with the buffer tube, thereby preventing fiber retraction.

[0002] Fiber retraction refers to the movement of fibers into a cable when the cable is subjected to a tensile load. Fiber retraction occurs when fibers are not properly coupled to the cable. As the cable stretches longitudinally, the fibers want to remain in their unstrained state, and if they are not sufficiently coupled to the cable, the ends of the fibers retract into the cable.

[0003] Fiber retraction most commonly occurs in central tube fiber optic cable. A central tube cable typically consists of loose fibers within a buffer tube in the center of the cable. Strength members are usually located outside the buffer tube, typically embedded in the outer jacket. A central tube cable can also consist of multiple fiber bundles, ribbons, or even smaller buffer tubes. Many times this central buffer tube is called a core tube, core buffer tube or even an inner jacket.

[0004] When a cable is installed between termination points, the cable is subject to tension. One such installation is an aerial installation, where the cable is subject to tension due to the weight of the cable as well as other loads due to wind and ice build-up on the cable. When subjected to these loads, the cable elongates. The strength members in the cable control the amount of elongation. If the components within the cable are properly coupled together, they will all strain in equal amounts. The strength members, jacket, buffer tube(s) and fibers will all strain equally. However, if the components are not coupled together, it is possible that the components can behave differently from each other. It is possible for the cable components to move relative to each other in order to relieve the strain. A common example is a central tube cable with loose fibers in a central buffer tube. The fibers are typically loosely embedded in a filling gel within that buffer tube.

[0005] In FIGs. 1A-1C, the interaction between the fiber 10 and the cable 12 is demonstrated. In FIG. 1A, the case is presented where there is no tension on the cable 12. Here, both the cable strain and the fiber strain are equal to zero. Note that the lengths of the cable and fiber are equivalent in this state. Turning to FIG. 1B, the case is presented where the cable is under tension and the fiber 10 and cable 12 are sufficiently coupled together. In this case, the cable has elongated as a result of the tension force by an amount 14. However, because the fiber and cable are sufficiently coupled, the cable strain is equivalent to the fiber strain. Thus, the relative length of the fiber to the cable remains unchanged, and no retraction is observed. Finally, in the case of FIG. 1C, the fiber 10 and cable 12 are not sufficiently coupled together. As a result, when the tension force is applied, the cable elongates by an amount 16, but the fiber does not elongate by the same amount. This lack of adequate coupling leads to the fiber retracting into the cable.

[0006] Fiber retraction can lead to significant disruptions in network function. In the case of aerial installations, the ends of the cable segments are connected to a splice closure. Strength members secure the cable to the closure. When tensile load is applied to the cable due to sag, wind, ice, or some other means, the load is designed to be taken by the strength members. If the fibers are not sufficiently coupled to the cable, the fibers are free to move axially within the central cavity of the cable. If the fibers can move freely, this can result in the fibers being pulled out of splice closures as they retract into the cable. This causes problems with the splice closures and severely, if not detrimentally, affects optical performance of the fiber and cable.

[0007] Several methods have been developed to prevent fiber retraction. Such methods include the application of glue-type sealant at the ends of the cable to bond the cable components together, leaving extra slack in the splice closures to compensate for the retractions, and the use of coupling coils. However, each of these conventional methods has their own negative implications.

[0008] More specifically, one of the conventional approaches previously used to address the problem of fiber retraction is to implement coupling coils which involves forming a portion of the cable into a loop or a plurality of loops. This results in frictional coupling of the internal fibers to the buffer tube to prevent the fiber from moving relative to the other members of the cable. However, because the minimum bend radius of the cable is dictated by the external members of the cable, such as the jacket and strength members, conventional coupling coils can be quite large and bulky. These conventional coupling coils typically exceed well over 1 foot (30.5 cm) in diameter. Such large coupling coils are undesirable since they are visually unpleasing in applications where cable is installed in residential areas, such as a fiber to the home installation. Further, in many cases, it is not possible to make large coils on telephone poles or lines due to proximity to other cables and/or right of way restrictions. Moreover, conventional coils require a significant length of cable to be utilized to form the large diameter coil, which results in increased installation expense.

[0009] Japanese patent application JP 2002-311315 discloses a method of installing a fiber optic cable and a cable installation including a fiber optic cable. The fiber optic cable is attached along a supported messenger wire, and the surplus length portion of the fiber optic cable is formed into a coil having at least one loop. The coil formed from the surplus length portion of the fiber optic cable is supported by a metal fitting, fitted in a vertical direction to an armature fixed to a pole in a horizontal direction of the messenger wire, wherein the messenger wire is attached to the fitting.

[0010] Thus, it is desirable to prevent fiber retraction by achieving coupling between the fiber and the cable

without the drawbacks associated with conventional approaches.

BRIEF SUMMARY OF THE INVENTION

[0011] The present invention is based on Japanese patent application JP 2002-311315 and is directed towards a method of installing a fiber optic cable according to claim 1 and towards a cable installation comprising a fiber optic cable according to claim 9.

[0012] The method comprises the steps of exposing a portion of the buffer tube over a predetermined length; and forming the exposed portion of the buffer tube into a first coupling coil having at least one loop. Preferably, the coupling coil is located in proximity to a first end of the cable such that it can be disposed in a splice enclosure. The method may also include the step of exposing a second portion of the buffer tube over a predetermined length and forming the exposed second portion of the buffer tube into a second coupling coil having at least one loop. The second coupling coil is also preferably disposed in at the opposite end of the cable and positioned inside a second splice enclosure.

[0013] The present invention further provides a fiber optic cable comprising at least one optical fiber; a buffer tube in which the optical fiber is disposed; a jacket surrounding the buffer tube, wherein the buffer tube includes an exposed portion which is exposed to outside the jacket over a predetermined length; and a coupling coil, having at least one loop, formed from the exposed portion of the buffer tube.

[0014] The cable of the present invention preferably includes the first and second coupling coils located in the splice enclosures. Advantageously, the present invention provides a coupling coil with a significantly smaller diameter than prior methods. Further, the smaller coupling coil can be placed inside a closure to provide a more visually pleasing cable termination.

[0015] Cable terminations according to the present invention also yield savings in time and effort, and further require less cable in their installation.

[0016] These and other features, aspects, and advantages of the present invention will become better understood with reference to the following description and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIGs. 1A-1C shows a fiber optic cable and the effect of tension on the cable when coupling is and is not present;

FIG. 2 shows a coupling coil with the forces involved in a cable termination;

FIGs. 3A and 3B show detail of a fiber optic cable and a coupling coil termination according to the present invention; and

FIG. 4 shows a cable installation wherein the cable is aerially suspended between termination points with two coupling coils.

FIG. 5 shows a chart depicting test results for buffer tube coupling coils according to the present invention.

DETAILED DESCRIPTION

[0018] The present invention will now be described with reference to FIGs. 2-5. Fiber retraction can be prevented in cable installations by utilizing coupling coils, preferably located in terminations or splice closures. Coupling coils operate under the principal of utilizing sidewall friction of a coil, often times termed the capstan effect. The capstan effect is demonstrated in FIG. 2, where the reaction force F1 required to counteract the applied load F2 is exponentially related to friction factor (f) and number of wraps (θ). This relationship can be expressed as $F_2 = F_1 e^{f\theta}$.

[0019] FIGs. 3A and 3B show a cable according to the present invention. The components of a fiber optic cable are described with respect to FIG 3A. Fiber optic cable 31 includes at least one fiber 32 disposed in a buffer tube 33 and a jacket 34 surrounding the buffer tube. The cable may also include strength members 35 which assist in transferring the load on the cable 31 and may be used to secure the cable to a termination point.

[0020] Turning to FIG. 3B, the termination of a fiber optic cable according to the present invention is presented. Cable 31 is attached to a wedge clamp 36 to support the cable weight. For example, the clamp 36 may clamp the strength member(s) of the cable. Although a wedge clamp is shown, other methods of supporting the cable weight may be employed, including methods which attach to strength members of the cable.

[0021] A portion of the buffer tube 33 is exposed over a predetermined length 37. The manner of exposing the buffer tube should not damage the buffer tube or any fibers disposed within. The length chosen is not critical but should be chosen with consideration of the length required for the coil to be formed and the length required for the end of the fiber to be terminated. If the cable includes any external members in addition to the jacket, such as strength members and armor, these members should be removed during the exposure of the buffer tube.

[0022] The exposed portion of the buffer tube 33 is formed into a coupling coil 38 having at least one loop. Coupling coil 38 can be formed by winding the predetermined length 37 of the buffer tube 33 into a plurality of loops of substantially equal diameter. The use of multiple loops increases the coupling effect. The coupling coil 38 may be secured with at least one fastener (not shown). The precise location where coupling coil 38 is formed is not critical. However, it is preferable that the coupling coils be located at the ends of the cable so that they can be received in the splice enclosures, as discussed below.

Additionally, more than one coupling coil may be formed at each termination. Furthermore, coupling coils according to the present invention may be located at any point on the cable if the weight of the cable is adequately supported.

[0023] As mentioned previously, the coupling effect achieved by coupling coils is related to the number of loops in the coupling coil. This effect is demonstrated with reference to the chart shown in FIG. 5, which depicts the fiber retraction observed without buffer tube coupling coils and when buffer tube coupling coils of 1 to 5 loops are employed in a cable termination with a coupling coil formed at each end of the cable, as shown. The horizontal axis of shows the number of loops formed in each coupling coil, ranging from zero loops (no coupling coils) to coupling coils with five loops, and the vertical axis depicts the percentage of fiber retraction observed. Results are provided for the fiber retraction observed at zero minutes, 30 minutes, 60 minutes, and 120 minutes. In the case where no coupling coils at all are used (zero loops), a substantial fiber retraction of 0.38% occurs at 120 minutes. This retraction is irreversible. In the case of buffer tube coupling coils with a single loop, a significantly smaller percentage of fiber retraction occurs, wherein the percentage of fiber retraction is 0.33% at 120 minutes. Further, when buffer tube coupling coils with two loops are utilized, the fiber retraction observed at 120 minutes is less than 0.10%. Finally, in the case of coupling coils with three to five loops, no fiber retraction occurs.

[0024] Referring again to FIG. 3B, the fiber (or fibers) disposed within the exposed buffer tube 33 is terminated at a first termination 39. The coupling coil 38 may advantageously be located within a splice closure 40 to hide the termination in installations where visually pleasing installations are desirable, such as in residential areas for fiber to the home installations.

[0025] FIG. 4 shows an aerial installation, wherein cable 41 is suspended between a first termination point 42 and a second termination point 43. Cable 41 is a fiber optic cable suitable for aerial installations with a similar structure to the fiber optic cable described in FIG 3A, where the structure of the cable comprises at least one fiber disposed in a buffer tube and a jacket surrounding the buffer tube with strength member(s) which assist in transferring the load on the cable. A further example of a fiber optic cable for use in aerial installations is described in U.S. Patent No. 6,459,837 to Fitz et al., the disclosure of which is hereby incorporated in its entirety.

[0026] Returning to FIG. 4, further details of the aerial installation are provided wherein a first portion of the buffer tube 44 of cable 41 is exposed over a predetermined length 45. The exposed first portion of the buffer tube 44 is formed into a first coupling coil 46 having at least one loop. Further, a second portion of the buffer tube 47 is exposed over a second predetermined length 48. The exposed second portion of the buffer tube 47 is formed into a second coupling coil 49. As in the previous case, coupling coils 46 and 49 may be formed by winding the exposed portion of the buffer tube 44 and 47 into a plurality of loops of substantially equal diameter.

[0027] Further, as discussed above, cable 41 is attached to wedge clamps 50 and 51 to support the weight of the cable. As stated previously, other methods of supporting the weight of the cable may be employed. At the end of the first portion of the buffer tube 46, fiber or fibers disposed within the buffer tube are terminated at a first termination 42. Likewise, at the end of the second portion of the buffer tube 47, fiber or fibers disposed within the buffer are terminated at a second termination 43.

[0028] A first splice closure 52 may enclose first termination 42, first coupling coil 46 and wedge 50. Similarly, a second splice closure 53 may enclose second termination 43, second coupling coil 49 and wedge 51. First splice closure 52 may be mounted on utility pole 54 and second splice closure 53 may be mounted on utility pole 55 to suspend cable 41.

[0029] As can be appreciated from the foregoing, the present invention involves the use of buffer tube coupling coils formed by winding the buffer tube into small coils. These buffer tube coils are significantly smaller than conventional coupling coils because the coils are formed without the external members of the cable. Because of the small size of the buffer tube coupling coils, they can be easily stored within a splice closure to provide a more visually appealing termination.

[0030] The buffer tube coupling coil works on the same principle as the cable coupling coil. Because the relative movement is between the fibers and the buffer tube, only these two components are required to be in a coil. Taking advantage of the observation that the other components such as the jacket, armor, and strength members need not be in the coil to achieve coupling, the coil diameter is limited only by the minimum allowable bend radius of the fiber and buffer tube.

[0031] Typically, fibers are limited to a 1 inch (2.54 cm) bend radius or a 2 inch (5.08 cm) bend diameter. Cables, however, usually have a minimum bend radius of 10 times their diameter. Armored cables require even larger bend radii. For a 1 inch (2.54 cm) diameter cable, the minimum cable bend radius would be 10-20 inches (25.4 - 50.8 cm) or more. Thus, a buffer tube coupling coil that can achieve the coupling needed to prevent fiber retraction without the substantial coil diameter of conventional coupling coils is highly desirable.

[0032] The fibers are coupled to the buffer tube by the friction between the fibers and the inner walls of the buffer tube. As with a conventional cable coil, in a buffer tube coil, the friction force holding the components together increases exponentially with the number of loops within the coil. Thus, the coupling force of a conventional cable coil and a buffer tube coil are theoretically equivalent.

[0033] In some fiber optic cables, the fibers are disposed within a buffer tube, and the buffer tube is filled with a gel substance. However, the use of buffer tube coupling coils is not limited to loose fibers in a gel-filled buffer tube. This method can also be used in a dry buffer

tube, for ribbons in a dry buffer tube, for ribbons in a gel-filled buffer tube, for multiple fiber bundles in a buffer tube, for miniature buffer tubes in a larger buffer tube, and other applications. It is believed that fiber retraction is a potential problem for all non-stranded fiber-optic cables where the buffer tube and/or fiber length is the same as the cable length. If the fibers are not sufficiently coupled to the cable, retraction can occur.

[0034] The buffer tube coupling coil would typically be formed by hand-winding the required length of buffer tube into loose, unsupported loops of substantially equal diameter. Alternatively, the buffer tube coupling coil could be formed by winding the required length of buffer tube around a supporting mandrel or ring. The mandrel or ring could be removed after the coupling coil is formed, or could remain in place to help prevent kinking or collapse of the tube coils.

[0035] A number of techniques could be used to secure the loops together (to keep the coupling coil from uncoiling), or to secure the loops to the mandral or ring (if used). These techniques may include adhesive tape, tie wraps, shrink wraps, spiral wraps and the like. At least one fastener may be used to secure the coupling coil, and multiple fasteners may be employed at different locations of the coil to secure it. Regardless of the securing technique employed, it should be non-damaging to the buffer tube material or structure.

[0036] Applications of the present invention are not limited to fiber optic cables with fiber disposed within a buffer tube. It is contemplated that the present invention is equally applicable to other types of cable installations other than optical fiber cables. The present invention contemplates termination of any cable including at least one internal member disposed within a central tube and an external member surrounding the tube, wherein the method comprises the steps of exposing a portion of the central tube to be over a predetermined length, and forming the exposed portion of the central tube into a coupling coil having at least one loop. The forming step can include forming the coupling coil in the proximity of an end of the cable.

[0037] The present invention provides numerous advantages over prior approaches discussed in the background. Among these are small size, where a buffer tube coupling coil may be more than 10 times smaller than a conventional cable coupling coil. Further, buffer tube coupling coils can be placed into closures and out of sight. Because of their very small size, buffer tube coupling coils can be easily placed in the closures at either end of the cable. Also, the smaller buffer tube coupling coil is very easy to make in comparison to making the much larger cable coupling coils.

[0038] Additionally, significantly less cable is required to make a buffer tube coupling coil. For example, for a 1 inch (2.54 cm) cable, approximately 20 feet (6 m) of extra cable is needed to make a cable coupling coil, where only 2 feet (0.6 m) of extra buffer tube is needed to make a buffer tube coupling coil with four loops. The buffer tube coupling coil achieves the same effect of preventing fiber retraction as the conventional coupling coil with less cable required, thereby providing significant economic benefits to the installer.

[0039] Furthermore, buffer tube coupling coils can be used for multiple designs, such as fibers in a dry tube, ribbon in a dry tube, ribbon in a gel-filled buffer tube, multiple fiber bundles in a dry or gel-filled buffer tube, miniature buffer tubes in a larger buffer tube, and others.

[0040] The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

List of reference numerals

[0041]

10	Fiber
12	Cable
14	Elongation amount
16	Elongation amount
31	Fiber optic cable
32	At least one fiber
33	Buffer tube
34	Jacket
35	Strength members
36	Wedge clamp
37	Predetermined length
38	Coupling Coil
39	First termination
40	Splice closure
41	Cable
42	First termination point
43	Second termination point
44	First portion of buffer tube
45	Predetermined length
46	First coupling coil
47	Second portion of buffer tube
48	Second predetermined length
49	Second coupling coil
50 and 51	Wedge clamps
52	First splice closure
53	Second splice closure
54 and 55	Utility poles

Claims

1. A method of installing a fiber optic cable (31; 41) comprising the steps of attaching the fiber optic cable (31; 41) to a support (36; 50; 51) and forming a portion of the fiber optic cable (31; 41) into a coil (38; 46) having at least one loop, **characterized in that**

said fiber optic cable (31; 41) comprises at least one optical fiber (32) disposed in a buffer tube (33; 44) and a jacket (34) surrounding said buffer tube (33; 44), **in that** said fiber optic cable is attached to a clamp (36; 50; 51) for supporting the cable weight, and **in that** said step of forming a portion of said fiber optic cable (31; 41) into a coil (38; 46) comprises a step of exposing a portion of said buffer tube (33; 44) outside said jacket (34) over a predetermined length (37; 45) and a forming step of forming said exposed portion of said buffer tube (33; 44) of said fiber optic cable (31; 41) into a first coupling coil (38; 46) having at least one loop.

2. The method of claim 1, wherein said forming step includes forming said first coupling coil (38; 46) in proximity to a first end of said fiber optic cable (31; 41).

3. The method of claim 1 or 2, further comprising a step of exposing a second portion of said buffer tube (47) over a predetermined length (48) and a forming step of forming said exposed second portion of said buffer tube (47) into a second coupling coil (49) having at least one loop.

4. The method of claim 3, wherein said forming steps includes forming said first coupling coil (46) in proximity to a first end of said fiber optic cable (41) and forming said second coupling coil (49) in proximity to a second end of said fiber optic cable (41).

5. The method of claim 3 or 4, further comprising a step of suspending said fiber optric cable (41) between a first termination point (42) and a second termination point (43) respectively defined by first and second splice closures (45; 53).

6. The method of claim 5, wherein said first coupling coil 46) is located within said first splice enclosure (45) and said second coupling coil (49) is located within said second splice closure (53).

7. The method of claim 1, 2, 3, 4, 5 or 6, wherein said fiber optic cable (31; 41) further comprises at least one strength member (35), and wherein the method further comprises a step of removing said strength member (35) over the predetermined length (37; 45; 48)).

8. The method of claim 1, 2, 3, 4, 5, 6 or 7 wherein said forming step includes a step of winding a length of buffer tube (33; 44) exposed outside said jacket (34) of said fiber optic cable (31; 41) into a plurality of loops of substantially equal diameter.

9. A cable installation (40; 52; 53) comprising a fiber optic cable (31; 41) including a portion formed into a coil (38; 46; 49) having at least one loop, wherein said fiber optic cable (31; 41) is attached to a support (36; 50; 51), **characterized in that** said fiber optic cable (31; 41) includes at least one fiber (32) disposed in a buffer tube (33; 44; 47)) surrounded by a jacket (34), **in that** said fiber optic cable (31; 41) is attached to a clamp (36; 50; 51) for supporting the cable weight and **in that** said optical fiber cable (31; 41) includes a portion having said buffer tube (33; 44; 47) exposed outside said jacket (34) over a predetermined length (37; 45; 48), and **in that** a coupling coil (38; 46; 49) having at least one loop is formed from the exposed portion of said buffer tube (33; 44; 47) of said fiber optic cable (31; 41)

10. The cable installation of claim 9, wherein said coupling coil (38; 46; 49) is formed in proximity to an end of said fiber optic cable (31; 41).

11. The cable installation of claim 9 or 10, wherein said exposed portion is a first exposed portion and wherein said buffer tube (47) includes a second exposed portion extending a predetermined length (48), said second exposed portion including a second coupling coil (49) having at least one loop formed therein.

12. The cable installation of claim 11, wherein said first coupling coil (38; 46) is formed in proximity to a first end of said fiber optic cable (41) and said second coupling coil (49) is formed in proximity to a second end of said fiber optic cable (41).

13. The cable installation of claim 12, wherein said fiber optic cable (41) is suspended between the first and second ends of said fiber optic cable (41).

14. The cable installation of claim 13, further comprising first and second splice closures (52; 53) in which said first and second coupling coils (46; 49) are respectively disposed.

15. The cable installation of claim 11, 12, 13 or 14 wherein said first and second coupling coils (46; 49) comprise a plurality of loops.

16. The cable installation of claim 9, 10, 11, 12, 13, 14 or 15, further comprising at least one strength member (35) disposed inside said jacket (34), said strength member (35) being removed for the length of said fiber optic cable (31; 41) comprising said first and second coupling coils (38; 46; 49).

Patentansprüche

1. Verfahren zum Installieren eines Glasfaserkabels (31; 41), das die Schritte, das Glasfaserkabel (31; 41) an einer Halterung (36; 50; 51) anzubringen und

aus einem Bereich des Glasfaserkabels (31; 41) eine Spule (38; 46) zu bilden, die mindestens eine Windung aufweist, umfasst,
dadurch gekennzeichnet,
dass das Glasfaserkabel (31; 41) mindestens eine Glasfaser (32) umfasst, die in einem Pufferschlauch (33; 44) und in einer Ummantelung (34), die den Pufferschlauch (33; 44) umgibt, angeordnet ist,
dass das Glasfaserkabel zum Halten des Kabelgewichts an einer Klemme (36; 50; 51) angebracht ist, und
dass der Schritt eines Bildens einer Spule (38; 46) aus einem Bereich des Glasfaserkabels (31; 41) einen Schritt, in dem ein Bereich des Pufferschlauchs (33; 44) außerhalb der Ummantelung (34) über eine vorbestimmte Länge (37; 45) freigelegt wird, und einen Bildungsschritt, bei dem aus dem freigelegten Bereich des Pufferschlauchs (33; 44) des Glasfaserkabels (31; 41) eine erste Kopplungsspule (38; 36), die mindestens eine Windung aufweist, gebildet wird, umfasst.

2. Verfahren nach Anspruch 1, wobei der Bildungsschritt umfasst, die erste Kopplungsspule (38; 46) in Nähe eines ersten Endes des Glasfaserkabels (31; 41) zu bilden.

3. Verfahren nach Anspruch 1 oder 2, des Weiteren einen Schritt, bei dem ein zweiter Bereich des Pufferschlauchs (47) über eine vorbestimmte Länge (48) freigelegt wird und einen Bildungsschritt umfassend, bei dem aus dem freigelegten zweiten Bereich des Pufferschlauchs (47) eine zweite Kupplungsspule (49), die mindestens eine Windung aufweist, gebildet wird.

4. Verfahren nach Anspruch 3, wobei der Bildungsschritt umfasst, die erste Kopplungsspule (46) in der Nähe eines ersten Endes des Glasfaserkabels (41) zu bilden, und die zweite Kopplungsspule (49) in Nähe eines zweiten Endes des Glasfaserkabels (41) zu bilden.

5. Verfahren nach Anspruch 3 oder 4, des Weiteren einen Schritt umfassend, bei dem das Glasfaserkabel (41) zwischen einem ersten Endpunkt (42) und einem zweiten Endpunkt (43), die durch entsprechende erste und zweite Spleißverkleidungen (45; 53) definiert werden, aufgehängt wird.

6. Verfahren nach Anspruch 5, wobei die erste Kopplungsspule (46) innerhalb der ersten Spleißverkleidung (45) angeordnet ist und die zweite Kopplungsspule (49) innerhalb der zweiten Spleißverkleidung (53) angeordnet ist.

7. Verfahren nach einem der Ansprüche 1-6, wobei das Glasfaserkabel (31; 41) des Weiteren mindestens ein Festigkeitselement (35) umfasst, und wobei das Verfahren des Weiteren einen Schritt umfasst, bei dem das Festigkeitselement (35) über die vorbestimmte Länge (37; 45; 48) entfernt wird.

8. Verfahren nach einem der Ansprüche 1-7, wobei der Bildungsschritt einen Schritt umfasst, bei dem ein Stück des Pufferschlauchs (33; 44), das außerhalb der Ummantelung (34) des Glasfaserkabels (31; 41) freigelegt ist, in mehrere Windungen von im Wesentlichen gleichem Durchmesser aufgewickelt wird.

9. Kabeleinrichtung (40; 52; 53), die ein Glasfaserkabel (31; 41) umfasst, das einen Bereich aufweist, der in eine Spule (38; 46; 49) ausgebildet ist, die mindestens eine Windung aufweist, wobei das Glasfaserkabel (31; 41) an einer Halterung (36; 50; 51) angebracht ist,
dadurch gekennzeichnet,
dass das Glasfaserkabel (31; 41) mindestens eine Faser (32) aufweist, die in einem Pufferschlauch (33; 44; 47) angeordnet ist, der von einer Ummantelung (34) umgeben ist,
dass das Glasfaserkabel (31; 41) zum Halten des Kabelgewichts an einer Klemme (36; 50; 51) angebracht ist, und
dass das Glasfaserkabel (31; 41) einen Bereich aufweist, in dem der Pufferschlauch (33; 44; 47) außerhalb der Ummantelung (34) über eine vorbestimmte Länge (37; 45; 48) freigelegt ist, und
dass eine Kopplungsspule (38; 46; 49), die mindestens eine Windung aufweist, aus dem freigelegten Bereich des Pufferschlauchs (33; 44; 47) des Glasfaserkabels (31; 41) ausgebildet ist.

10. Kabeleinrichtung nach Anspruch 9, wobei die Kopplungsspule (38; 46; 49) in Nähe eines Endes des Glasfaserkabels (31; 41) ausgebildet ist.

11. Kabeleinrichtung nach Anspruch 9 oder 10, wobei der freigelegte Bereich ein erster freigelegter Bereich ist, und wobei der Pufferschlauch (47) einen zweiten freigelegten Bereich aufweist, der sich über eine vorbestimmte Länge (48) erstreckt, wobei der zweite freigelegte Bereich eine zweite Kopplungsspule (49) aufweist, die mindestens eine darin ausgebildete Windung aufweist.

12. Kabeleinrichtung nach Anspruch 11, wobei die erste Kopplungsspule (38; 46) in Nähe eines ersten Endes des Glasfaserkabels (41) ausgebildet ist und die zweite Kopplungsspule (49) in Nähe eines zweiten Endes des Glasfaserkabels (41) ausgebildet ist.

13. Kabeleinrichtung nach Anspruch 12, wobei das Glasfaserkabel (41) zwischen dem ersten und dem zweiten Ende des Glasfaserkabels (41) aufgehängt ist.

14. Kabeleinrichtung nach Anspruch 13, des Weiteren umfassend eine erste und eine zweite Spleißverkleidung (52; 53), in welcher die erste bzw. die zweite Kopplungsspule (46; 49) angeordnet ist.

15. Kabeleinrichtung nach einem der Ansprüche 11-14, wobei die ersten und zweiten Kopplungsspulen (46; 49) mehrere Windungen umfassen.

16. Kabeleinrichtung nach einem der Ansprüche 9-15, des Weiteren mindestens ein Festigkeitselement (35) umfassend, das im Inneren der Ummantelung (34) angeordnet ist, wobei das Festigkeitselement (35) über die Länge des Glasfaserkabels (31; 41), die die ersten und zweiten Kopplungsspulen (38; 46; 49) umfasst, entfernt ist.

Revendications

1. Procédé d'installation d'un câble à fibres optiques (31 ; 41) comprenant les étapes d'assujettissement du câble à fibres optiques (31 ; 41) à un support (36 ; 50 ; 51) et de formation d'une partie du câble à fibres optiques (31 ; 41) en un enroulement (38 ; 46) comportant au moins une boucle, **caractérisé en ce que** ledit câble à fibres optiques (31 ; 41) comprend au moins une fibre optique (32) disposée dans un tube tampon (33 ; 44) et une gaine (34) entourant ledit tube tampon (33 ; 44), **en ce que** ledit câble à fibres optiques est assujetti à une bride (36 ; 50 ; 51) destinée à supporter la masse de câble, et **en ce que** ladite étape de formation d'une partie dudit câble à fibres optiques (31 ; 41) en un enroulement (38 ; 46) comprend une étape d'exposition d'une partie dudit tube tampon (33 ; 44) à l'extérieur de ladite gaine (34) sur une longueur prédéterminée (37 ; 45) et une étape de formation permettant de former ladite partie exposée dudit tube tampon (33 ; 44) dudit câble à fibres optiques (31 ; 41) en un premier enroulement (38 ; 46) de couplage comportant au moins une boucle.

2. Procédé selon la revendication 1, dans lequel ladite étape de formation inclut la formation dudit premier enroulement (38 ; 46) de couplage à proximité d'une première extrémité dudit câble à fibres optiques (31 ; 41).

3. Procédé selon la revendication 1 ou 2, comprenant en outre une étape d'exposition d'une seconde partie dudit tube tampon (47) sur une longueur prédéterminée (48) et une étape de formation consistant à former ladite seconde partie exposée dudit tube tampon (47) en un second enroulement (49) de couplage comportant au moins une boucle.

4. Procédé selon la revendication 3, dans lequel lesdites étapes de formation comprennent la formation dudit premier enroulement (46) de couplage à proximité d'une première extrémité dudit câble à fibres optiques (41) et de formation dudit second enroulement (49) de couplage à proximité d'une seconde extrémité dudit câble à fibres optiques (41).

5. Procédé selon la revendication 3 ou 4, comprenant en outre une étape de suspension dudit câble à fibres optiques (41) entre un premier point (42) de terminaison et un second point (43) de terminaison définis, respectivement, par des première et seconde enceintes (45 ; 53) d'épissure.

6. Procédé selon la revendication 5, dans lequel ledit premier enroulement (46) de couplage est situé à l'intérieur de ladite première enceinte (45) d'épissure et ledit second enroulement (49) de couplage est situé à l'intérieur de ladite seconde enceinte (53) d'épissure.

7. Procédé selon la revendication 1, 2, 3, 4, 5 ou 6, dans lequel ledit câble à fibres optiques (31 ; 41) comprend en outre au moins un élément résistant (35), et dans lequel le procédé comprend en outre une étape de retrait dudit élément résistant (35) sur une longueur prédéterminée (37 ; 45 ; 48).

8. Procédé selon la revendication 1, 2, 3, 4, 5, 6 ou 7, dans lequel ladite étape de formation inclut une étape d'enroulement d'une longueur de tube tampon (33 ; 44) exposée à l'extérieur de ladite gaine (34) dudit câble à fibres optiques (31 ; 41) en une pluralité de boucles de diamètre sensiblement égal.

9. Installation (40 ; 52 ; 53) de câble, comprenant un câble à fibres optiques (31 ; 41) incluant une partie formée en un enroulement (38 ; 46 ; 49) comportant au moins une boucle, dans laquelle ledit câble à fibres optiques (31 ; 41) est assujetti à un support (36 ; 50 ; 51), **caractérisée en ce que** ledit câble à fibres optiques (31 ; 41) inclut au moins une fibre (32) disposée dans un tube tampon (33 ; 44 ; 47) entouré par une gaine (34), **en ce que** ledit câble à fibres optiques (31 ; 41) est assujetti à une bride (36 ; 50 ; 51) destinée à supporter la masse de câble, et **en ce que** ledit câble à fibres optiques (31 ; 41) inclut une partie comportant ledit tube tampon (33 ; 44 ; 47) exposée à l'extérieur de ladite gaine (34) sur une longueur prédéterminée (37 ; 45 ; 48), et **en ce qu'**un enroulement (38 ; 46 ; 49) de couplage comportant au moins une boucle est formé à partir de la partie exposée dudit tube tampon (33 ; 44 ; 47) dudit câble à fibres optiques (31 ; 41).

10. Installation de câble selon la revendication 9, dans laquelle ledit enroulement (38 ; 46 ; 49) de couplage est formé à proximité d'une extrémité dudit câble à

fibres optiques (31 ; 41).

11. Installation de câble selon la revendication 9 ou 10, dans laquelle ladite partie exposée est une première partie exposée et dans laquelle ledit tube tampon (47) inclut une seconde partie exposée s'étendant sur une longueur prédéterminée (48), ladite seconde partie exposée incluant un second enroulement (49) de couplage comportant au moins une boucle formée dans celui-ci.

12. Installation de câble selon la revendication 11, dans laquelle ledit premier enroulement (38 ; 46) de couplage est formé à proximité d'une première extrémité dudit câble à fibres optiques (41), et ledit second enroulement (49) de couplage est formé à proximité d'une seconde extrémité dudit câble à fibres optiques (41).

13. Installation de câble selon la revendication 12, dans laquelle ledit câble à fibres optiques (41) est suspendu entre les première et seconde extrémités dudit câble à fibres optiques (41).

14. Installation de câble selon la revendication 13, comprenant en outre des première et seconde enceintes (52 ; 53) d'épissure dans lesquelles lesdits premier et second enroulements (46 ; 49) de couplage sont disposés respectivement.

15. Installation de câble selon la revendication 11, 12, 13 ou 14, dans laquelle lesdits premier et second enroulements (46 ; 49) de couplage comprennent une pluralité de boucles.

16. Installation de câble selon la revendication 9, 10, 11, 12, 13, 14 ou 15, comprenant en outre au moins un élément résistant (35) disposé à l'intérieur de ladite gaine (34), ledit élément résistant (35) étant retiré sur la longueur dudit câble à fibres optiques (31 ; 41) comprenant lesdits premier et second enroulements (38 ; 46 ; 49) de couplage.

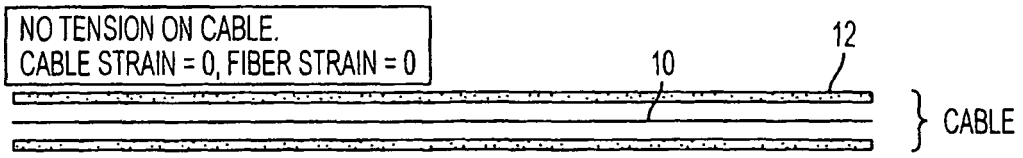


FIG. 1A

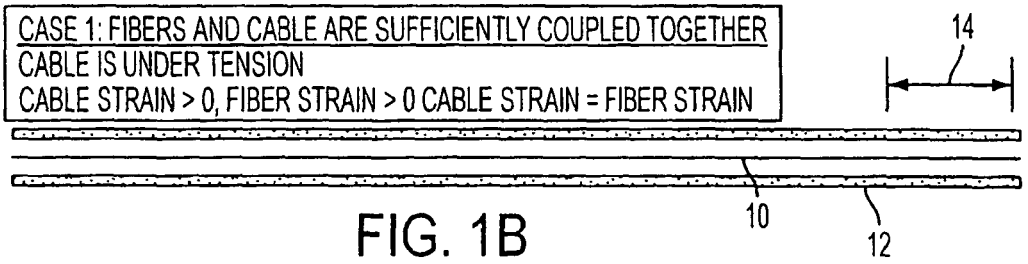


FIG. 1B

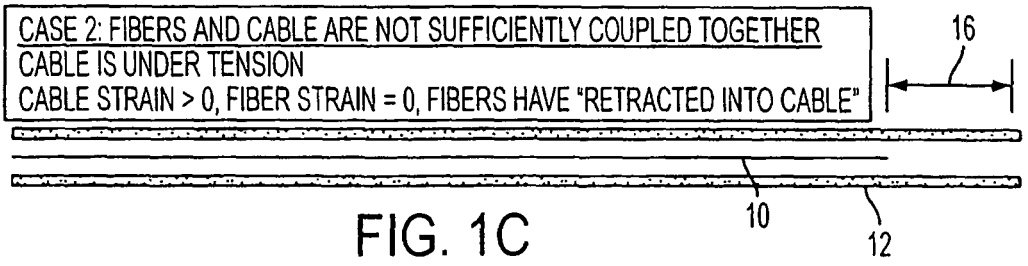


FIG. 1C

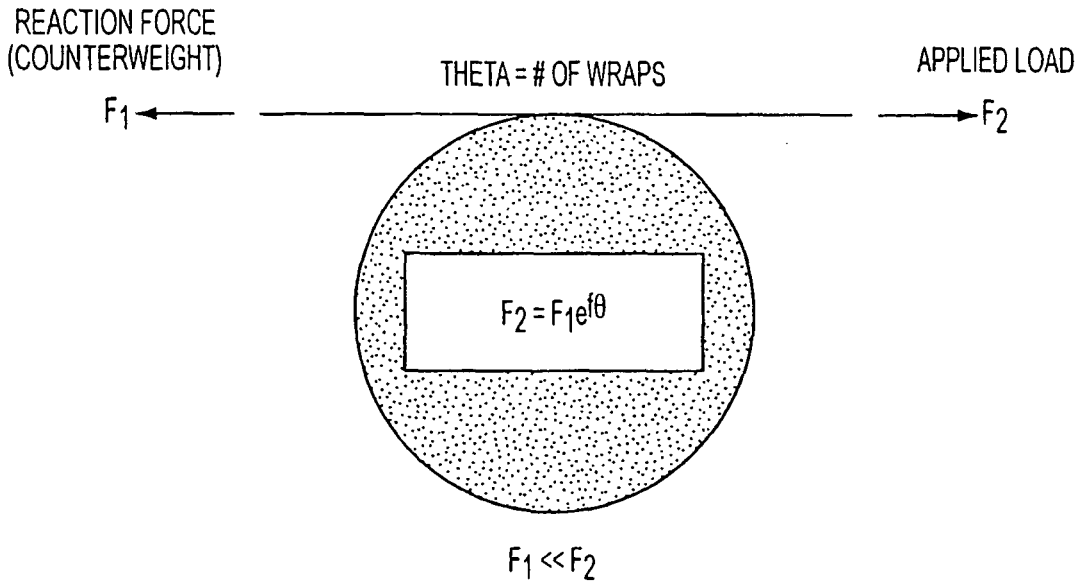

REACTION FORCE
(COUNTERWEIGHT)
F1
THETA = # OF WRAPS
APPLIED LOAD
F2
F2 = F1efθ
F1 << F2

FIG. 2

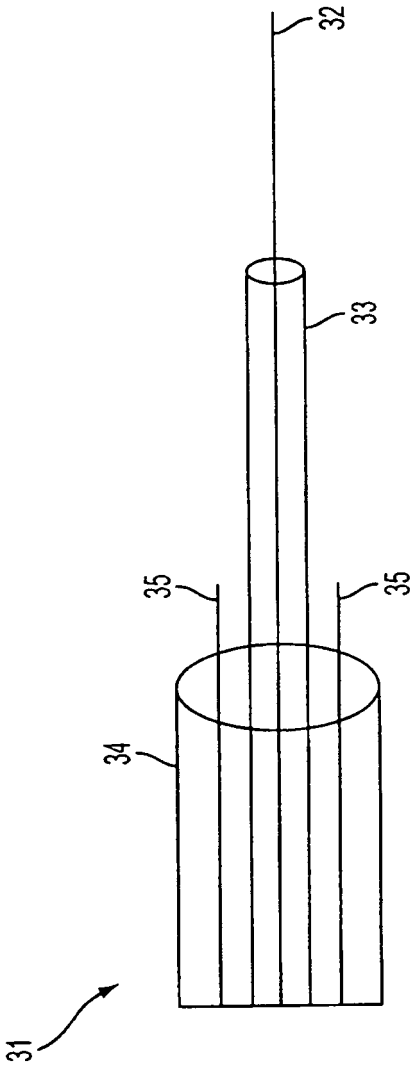


FIG. 3A

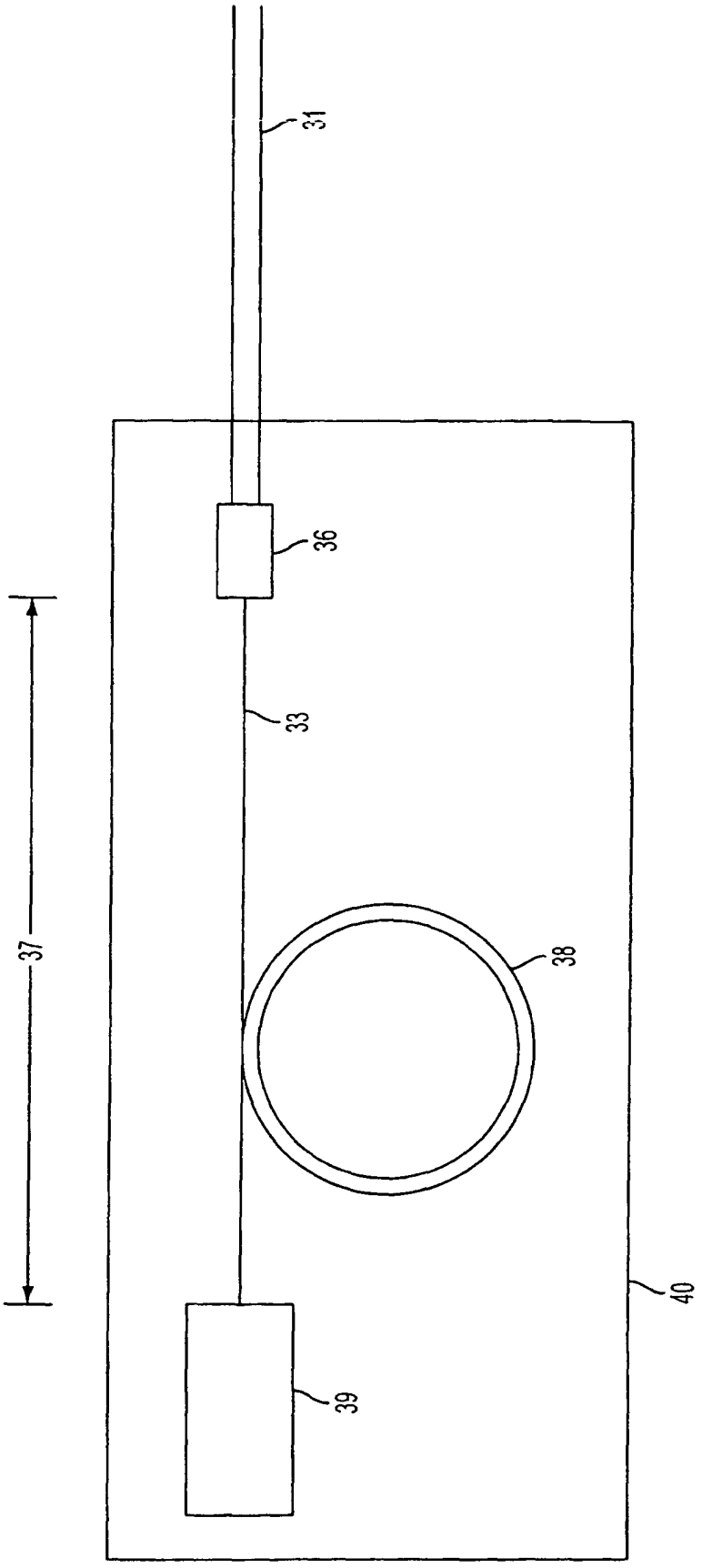


FIG. 3B

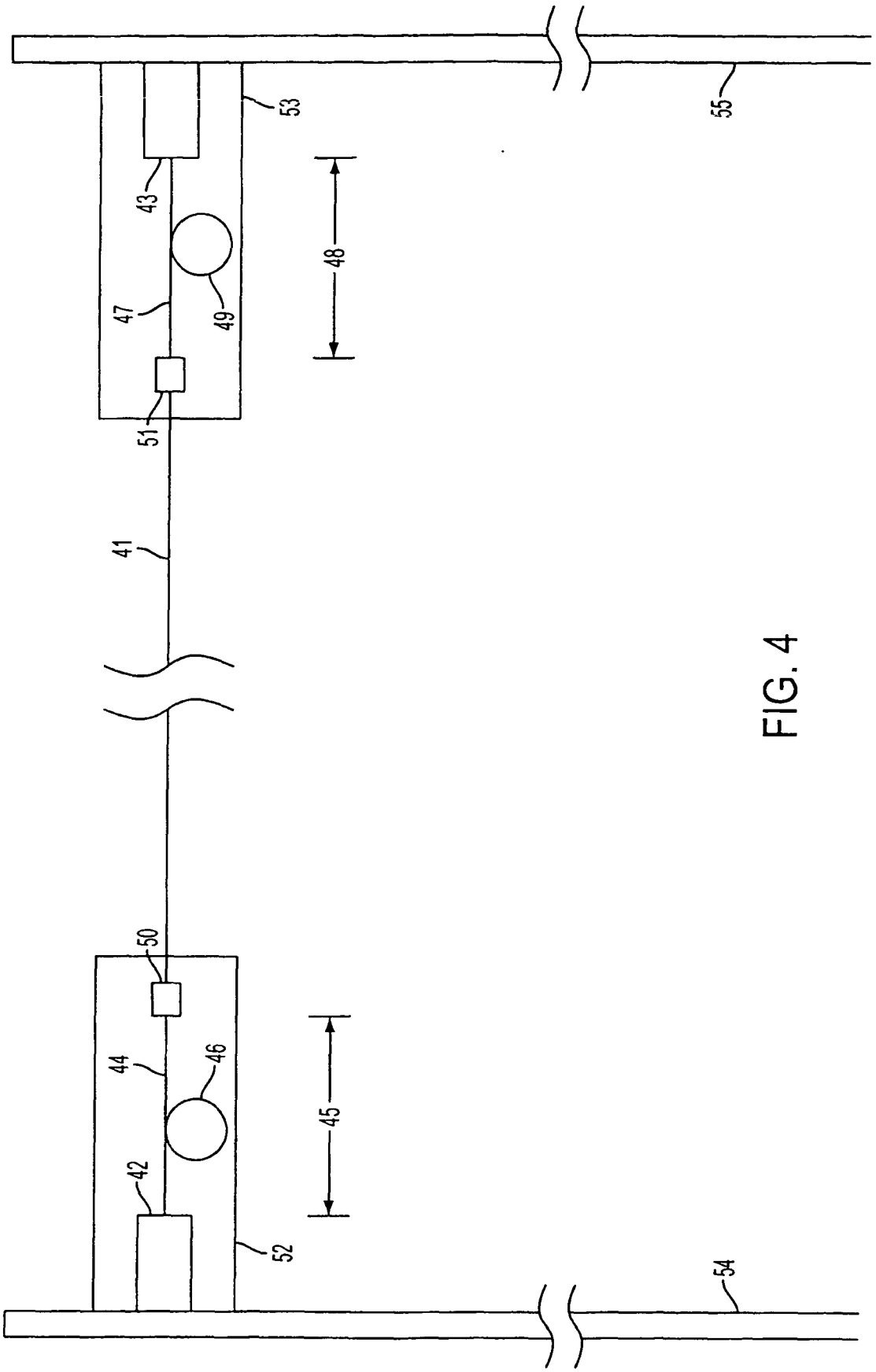
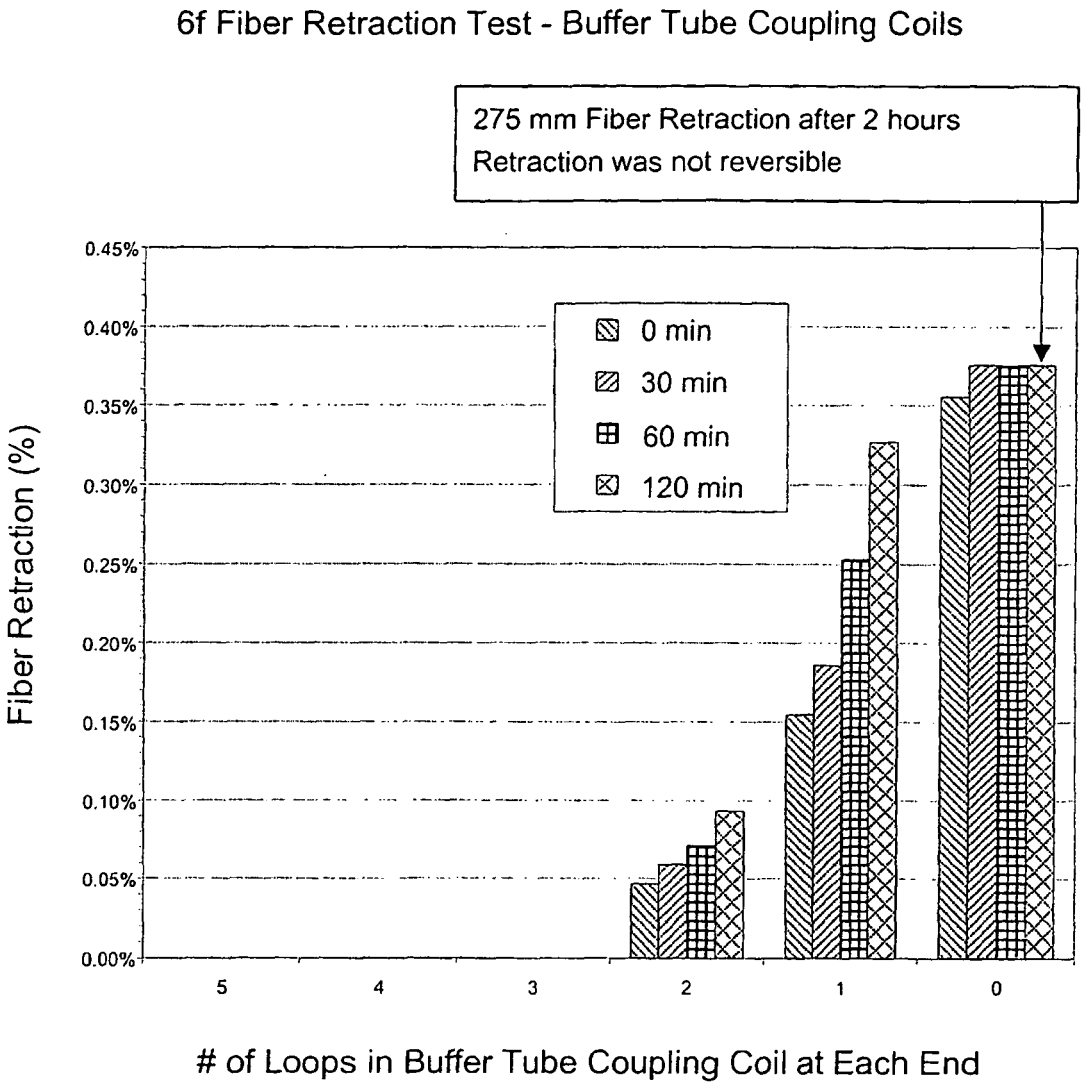


FIG. 4


6f Fiber Retraction Test - Buffer Tube Coupling Coils
275 mm Fiber Retraction after 2 hours
Retraction was not reversible
0 min
30 min
60 min
120 min
Fiber Retraction (%)
0.45%
0.40%
0.35%
0.30%
0.25%
0.20%
0.15%
0.10%
0.05%
0.00%
5
4
3
2
1
0
# of Loops in Buffer Tube Coupling Coil at Each End

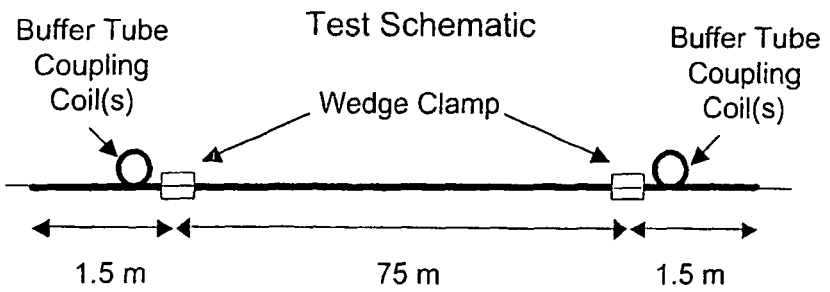

Test Schematic
Buffer Tube Coupling Coil(s)
Wedge Clamp
Buffer Tube Coupling Coil(s)
1.5 m
75 m
1.5 m

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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- US 6459837 B, Fitz **[0025]**